# 3.0 PROJECT OBJECTIVES AND APPROACH

## 3.1 INVESTIGATION RATIONALE AND APPROACH

The purpose of the in-water investigation was to further characterize the underwater debris and any resulting environmental impacts. The investigation area included the area surrounding the previously described piles, an additional survey area down stream of the piles and an upland portion of the island that includes the storm drain system (Figures 3 and 4). The data was also collected to assist the USACE in designing the best method for removing the debris.

The investigation included the following tasks:

- Collection and analysis of five primary water column samples from the area surrounding the underwater debris and an upgradient location[2] .
- Installation, retrieval and analysis of four primary semi-permeable membrane devices (SPMDs) from the area surrounding the underwater debris and from one upgradient location.
- Collection and analysis of six primary sediment samples from the area surrounding the underwater debris.
- Collection and analysis of tissue from two species of near-shore invertebrates.
- Underwater visual survey of the known debris piles to estimate the approximate volume, types of debris, and percent composition.
- Underwater visual survey of an additional survey area downstream of the known piles to identify any other areas of debris.
- Assessment of the storm drain system on the north side of the Sandblast Building, by collecting and analyzing sediment present in the drain catch basins and beneath the outfalls of the two drains.

## 3.2 CHEMICALS OF INTEREST

Previous investigations at the Bradford Island Landfill identified chemicals of interest (COIs) in the following chemical classes:

- Petroleum hydrocarbons (both gasoline and diesel)
- Pesticides
- Chlorinated herbicides
- PCBs

[2] Primary samples are collected to meet the objectives of the investigation as distinguished from quality assurance and quality control samples that are collected to characterize data quality.

- Metals
- VOCs
- SVOCs
- Butyltins

The selection of target chemical classes was based on the findings from previous investigations and the potential to be site contaminants based on past practices, rather than comparison of available data to human health or ecological health risk screening values.

## 3.3 DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) are qualitative and quantitative statements that clarify technical and quality objectives, describe the intended use of the data, define the appropriate type of data needed to support the decision, identify the conditions under which the data should be collected, and specify the acceptable level of uncertainty in the data.

The overall DQOs for this investigation were to develop and implement field measurements, laboratory analyses, and reporting that results in data quality that is consistent with its intended use. The intended uses of the data include the following:

- Evaluate sediment chemistry data against screening values and background concentrations.
- Assess the presence or absence of PCBs in near-shore invertebrates.
- Assess whether PCBs present in the sediment could partition into the water column during debris retrieval at concentrations above the ambient water quality screening values.
- Provide information to assist the USACE in developing removal methods for debris.
- Quantify the volume of submerged debris.
- Collect information to help assess if a surface release captured by upland storm drain system has impacted the near-shore sediments.
- Evaluate whether residual contamination is present in the stormwater drain system. Sample results do not verify causation.

## 3.4 OVERVIEW OF SAMPLING AND ANALYSIS PROGRAM

Samples were collected during the May 2001 In-Water Field Investigation. Sample locations and analyses are summarized in Table 3-1. Photos of the work performed are presented in Appendix B. All samples were collected in the manner described in the *Sampling and Analysis Plan, In-Water Investigation, Bradford Island Landfill, April, 2001* (URS, 2001b) unless otherwise specified below.

### 3.4.1 Comprehensive Survey

The survey work was conducted in the submerged near-shore areas north and east of the island between April 30 and May 3, 2001 to identify the presence, type and extent of debris. The survey was conducted in the manner described in the FSP with the following exception. Rather than group the observed waste in three categories (hazardous electrical items, possibly hazardous electrical items, miscellaneous debris), it was grouped into two categories: electrical items (to include lightening arrestors, interteen capacitors, light ballasts, switches, post insulators and other miscellaneous electrical equipment) and non-electrical debris (concrete, wire rope, etc). The distinction between hazardous and possibly hazardous electrical equipment was not practical because of the difficulty to accurately discern hazardous from non-hazardous items, based solely on underwater visual observations. The perimeters of the waste piles were delineated and the observed thickness of debris within each pile was recorded. Specific locations of electrical debris were recorded using differential global-positioning system (GPS) equipment and a hand-held rangefinder (see Figure 3).

The survey also extended downstream of the bounds of the previous survey (see Figure 4), and ended at the Sandblast Building drain outfalls. This survey included an area that consisted of the submerged near shore area 50 feet off the shore. This was conducted to observe any additional debris. Upon completion of the survey it became apparent that the debris on the north side of the island was one continuous pile (hereinafter known as Pile #2). This pile had previously been described as 2 separate piles in the FSP. Planned samples within the piles will be discussed together as the east and west portions of Pile #2.

A third pile was discovered in the extended survey area conducted as part of the work described in this report. The location of this pile (hereinafter known as Pile #3) is shown in Figure 3.

### 3.4.2 Water Column and Collocated Sediment Sample Collection

To assess potential release of contaminants to the water column during future retrieval of the electrical items, sediments from the river sampling areas were manually disturbed by a diver to entrain particulates in the water column. Immediately after disturbing the sediments, a sample of the water and associated suspended sediment was collected using a peristaltic pump. A diver assisted in this process by positioning the intake end of the tubing in the disturbed area. The entrained water and sediment were placed into a laboratory-provided jar. The water was separated from the sediment at the analytical laboratory. The particulate and dissolved portions of the sample were analyzed separately for PCBs.

Additional sediment samples were collected directly from the riverbed at the water sample locations, to help correlate the sediment data obtained with the water samples (described above) with the actual PCB content of the in-place sediments at the sample locations.

A total of nine water column and nine sediment samples were collected on May 2 and 3, 2001. Samples included five primary, one duplicate, one matrix spike (MS), one matrix spike duplicate (MSD) and one quality assurance sample. Of the five primary locations, three locations were

established within Pile #1, one location was established upstream of this pile to serve as a background location, and the remaining location was within Pile #2, near a lightning arrestor. The background location was on the shore of Goose Island, which is approximately 1,500 feet upstream of Bradford Island (Figure 2). Sample locations are shown in Figure 5. The sample locations within Pile #1 were located near previous sample locations, which indicate the presence of PCBs in these locations, to correlate those results with the existing data.

Samples were collected as described in the SAP. Sediment samples were characterized and logged by URS immediately after sampling. Copies of the field sampling data sheets are included in Appendix A.

### 3.4.3 Semi-Permeable Membrane Devices

The presence of PCBs in water can have biological consequences at concentrations below which it is possible to detect the contaminants in samples obtained using conventional sampling techniques. SPMDs can reveal occurrence of contamination at these environmentally-relevant levels (USGS, 1999). SPMDs are designed to mimic animal lipids; hydrophobic contaminants dissolve in the SPMD as they do in the lipid tissues of a fish. SPMD samples were collected to simulate passive diffusion of contaminants from wastes into the water column that would be available to accumulate in animal tissues.

The SPMD technology was developed by the U.S. Geological Survey (USGS) at the Columbia Environmental Research Center (Huckins et al, 1999). The SPMD consists of a membrane that is constructed from low-density polyethylene (LDPE). LDPE is essentially nonporous, although there are molecular-scale openings of approximately 10 angstrom (Å). After passing through these openings, the contaminants are sequestered onto a lipid film on the LDPE. After retrieval, the SPMDs are sent to the laboratory for analysis.

The standard SPMD configuration developed by the USGS were used (Huckins et al, 1999). The standard SPMD configuration (commercially available) consists of the following:

*Membrane*: LDPE layflat tubing manufactured without additives

*Sequestration Phase*: High-purity (95 percent) synthetic triolein

*Dimensions*: Generally 2.5-cm wide (layflat) by 91.4-cm-long LDPE tubes (75-95 micron wall thickness and surface area of approximately 450 square centimeters) containing 1 milliliter (0.915 gram) of triolein as a thin film. Other lengths and widths can also be used if the lipid-to-membrane mass ratio is approximately 0.2 and the membrane thickness is about the same.

Installation of the SPMD anchors was conducted according to the protocol specified in the SAP with the following exception: while three anchors were installed at the eastern portion of Pile #2 (which, as discussed, was previously thought to be a separate pile) as planned, one buoy line was caught in the boat prop rendering the anchor system unusable for SPMD installation. The remaining two anchor systems were installed to encompass upstream and downstream locations. Four of the anchor locations were selected for deploying SPMDs. One SPMD was placed

downstream (west) of Pile #1 and 2. The third SPMD was placed to the north of Pile #2. The fourth SPMD was deployed in the background location. Sample locations are presented in Figure 5.

The SPMDs were installed after samples were collected in order to allow a more accurate assessment of the steady state conditions.

LDPE strips of greater surface area without lipid were also collocated at selected SPMD anchor locations for reference samples. The analytical results of the LDPE strips alone will be considered for reference but will not be used to quantify PCB concentrations.

The SPMDs were deployed for 47 days. Originally, the SPMDs were to be removed after 15 days. The SPMD installation time was longer than intended because boats were not permitted in the area due to the Bonneville Power Administration's (BPA) unexpected decision to open the dam spillway to facilitate downstream fish passage on May 17, 2001.

It was necessary to retrieve the SPMDs by pulling up the entire anchor system rather than with the use of the pulley system because the SPMD anchor systems had become entangled in underwater debris during the period of deployment.

A total of nine SPMDs were analyzed by Battelle Pacific Northwest Laboratory in Sequim, Washington: four primary, one field duplicate, one equipment blank, one blank spike, one blank spike duplicate. The SPMDs were placed in an organic solvent to produce a dialysate. The SPMD dialysate was sent from Battelle to the USACE QA Laboratory for analysis as a quality assurance sample.

Analysis of the SPMD dialysate returns a concentration per gram of SPMD. The river water concentration was calculated using the theoretical relationship between the concentration of the compound *i* (Aroclor 1254 for this investigation) in water and in an SPMD during linear uptake and at equilibrium:

During linear uptake

$$C_{i,WATER} = \frac{C_{i,SPMD} \times V_{SPMD}}{R_i \times t}$$

At equilibrium

$$C_{i,SPMD} = C_{i,WATER} \times K_{i,SPMD} \times \left[ 1 - e^{\frac{-R_i \cdot t}{K_{i,SPMD} \cdot V_{SPMD}}} \right]$$

$C_{i,SPMD}$ = concentration of *i* in the SPMD in mass per volume of SPMD.

$C_{i,WATER}$ = constant concentration of *i* dissolved in water.

$K_{i,SPMD}$ = SPMD-water partition coefficient for *i*. $K_{i,SPMD} = 0.3K_{ow}$. The Log $K_{ow}$ for Aroclor 1254 is estimated to be 6.98[3], therefore the Log $K_{i,SPMD}$ is estimated to be 6.5.

[3] The estimated $K_{ow}$ was obtained from Environmental Science Center of Syracuse Research Corporation on-line database.

$R_i$ = SPMD sampling rate for *i.* Only sampling rates for congeners (not Aroclors) were available. Experimentally determined sampling rates for multiple congeners usually found in Aroclor 1254 were used in the model. Congeners 74, 84, 87, 91, 97, 99, 110, 118, 138, 128, 153 exhibited sampling rates ranging from 3.6 – 5.8 L/day[4]. The lowest, most conservative sampling rate of 3.6 L/day was used.

t = duration of the SPMD exposure (47 days).

$V_{SPMD}$ = total volume of the SPMD (4.9 ml).

The SPMD sampling rate (R) varies depending on environmental conditions such as SPMD biofouling, water temperature and water velocity. While these conditions were qualitatively assessed, the sampling rate was not adjusted to account for these environmental conditions because the nature of the dependence on these conditions cannot be accurately qualified. Because the environmental conditions are not accounted, the chemical concentrations calculated for the river water using SPMD data should be approximations. A study conducted in the Columbia River estimated the absolute error of the SPMD derived water concentrations not adjust for environmental concentrations to be less than an order of magnitude (USGS, 1999). In summary, while the absolute chemical concentrations should be considered approximations, the relative concentrations can be used with a higher degree of certainty. Finally, because environmental conditions at the various sampling locations were similar, data comparisons between these sampling locations can be made.

The length of time the SPMDs were exposed for uptake (47 days) has not been studied; it is not known whether the concentration of PCBs in the SPMDs was in the linear uptake phase, or had reached equilibrium at the time of collection. The most conservative model, the linear uptake equation, was used.

### 3.4.4 Sediment Sample Collection

Sediment samples were collected from Pile #1, Pile #2, and the background location. Samples were not collected from Pile #3. The samples were collected in different locations than the sediment collected for the water column samples. Half of the samples were analyzed for PCBs and TOC, while the other half were analyzed for the "full suite" of contaminants found at the upland landfill. The full analytical suite includes PCBs, petroleum hydrocarbons, total metals[5], organochlorine pesticides, chlorinated herbicides, SVOCs, and TOC. In general, the COI list was used to establish the suite of analyses for sediment samples. VOCs were not analyzed for because they were not expected to be recoverable in the sediment samples due to their volatile nature.

[4] SPMD sampling rates are from in the USGS SPMD study of the Lower Columbia River (USGS, 1999).
[5] Aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium (total), cobalt, copper, iron, lead, manganese, magnesium, mercury, potassium, nickel, selenium, silver, thallium, tin, vanadium, and, zinc.

A total of twelve sediment samples were collected on May 2 and 3, 2001. Samples included eight primary, one duplicate, one MS, one MSD and one quality assurance sample. Due to the coarse nature of the riverbed, an attempt was made to collect representative samples of the fine-grained sediment from concentrated areas between the cobbles. Samples were collected as described in the SAP with the following exception. At the request of DEQ, sediment samples were collected in Pile #2 where electrical debris was found. The SAP stated that sediment would not be collected if electrical debris were found. Sample locations are depicted in Figure 5. Sediment samples were characterized and logged by URS immediately after sampling. Copies of the field sampling data sheets are included in Appendix A.

### 3.4.5 Biological Tissue Collection

Aquatic invertebrate samples were collected and analyzed to assess whether there had been any uptake of PCBs by near-shore aquatic species. The species studied were crayfish (*Pacifastacus* sp.) and clams (*Corbicula fluminea*). These two invertebrates were not chosen based on a characterization of the benthic community, rather they were chosen because they have been observed during previous in-water surveys adjacent to the Bradford Island Landfill.

Eight clam samples were collected between April 30 and May 3, 2001: four primary, one duplicate, one MS, one MSD and one quality assurance sample. Eight crayfish samples were collected May 9 and June 19, 2001 (see below for explanation of the sampling dates): four primary, one duplicate, one MS, one MSD and one quality assurance sample. Samples of each invertebrate were collected from Pile #1, Pile #2, and from the upstream sampling location. Clam tissue sample locations are depicted in Figure 5 and sampling sheets indicating average clam sizes are included in Appendix A.

The crayfish were collected using traps, which were deployed for approximately two weeks. The bait used in the crayfish traps (canned tuna and salmon) was analyzed for PCBs prior to use. No PCBs were detected in the crawfish bait. Crayfish were collected on May 9, 2001 and then again on June 19, 2001. Sufficient numbers of crayfish were collected to submit samples from each of the four sampling locations, one field duplicate, one MS one MSD and one quality assurance sample. Approximate crayfish sample locations are depicted in Figure 5 and the number of crayfish collected and their sizes are presented in Table 3-2. Sampling sheets are included in Appendix A.

Although an attempt was made to select from all locations similarly-sized individuals for analysis, the average size of crayfish collected at the background location were much larger than crayfish collected at the debris piles. In addition, the average crayfish size at Pile #1 was smaller than at Pile #2. As a result, the tissue concentrations may not be directly comparable.

The tissue samples were prepared and analyzed by Battelle. The entire crayfish was blended and extracted for analysis. The clams were positively identified as *Corbicula* and were shucked before extraction and analysis.

### 3.4.6 Stormwater Drain Evaluation

The purpose of the stormwater drain evaluation was twofold: 1) to assess whether the historic PCB release near the Sandblast Building or other activities or discharges captured by upland storm drain system has impacted the near-shore sediments, and 2) to evaluate if residual contamination was present in the catch basins of the stormwater system.

Before sampling was conducted, the drainlines were located using standard utility locating techniques. The locations of the buried pipelines and the areas they drain were delineated and are presented in Figure 4.

A total of eight samples were collected from the catch basins and two outfalls. Four primary, one duplicate, one MS, one MSD and one quality assurance sample were collected. Sediment samples collected from the catch basin area were analyzed for PCBs, SVOCs, VOCs, metals, hydrocarbons, TOC and butyltins. Sediment samples collected from the two outfall areas were analyzed for PCBs, SVOCs, metals, hydrocarbons, TOC, total butyltins, and butyltins in pore water. Sample collection was conducted in the manner described in the SAP with the following exceptions. At drain catch basin # 2 the sediment volume was insufficient for analysis. A sample was collected from the area directly above the catch basin where the runoff appears to pool prior to entering the catch basin. Directly below both drain outfalls on the shoreline of the island, sediment volume was insufficient for analysis, this area is covered by riprap. Therefore, sediment samples were collected from the river bottom by a diver directly offshore from the outfalls. Sample locations are depicted in Figure 4.

### 3.4.7 Waste Management

Sample results of the debris removed during previous dives were reviewed to characterize the waste for disposal. The contents of the drums of IDW generated from past investigations and removal activities were also reviewed to identify the disposal options. Characterization and disposal-related activity is detailed in the technical memorandum in Appendix F.